Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

WINTER GRAZING IN THE ROCKY MOUNTAINS.

BY

GENERAL BENJAMIN ALVORD, U. S. ARMY.

It is esteemed a proper subject for consideration and record in the American Geographical Society, that during the last fourteen years a revelation has dawned on the people of the United States, respecting the resources for winter grazing in the whole Rocky mountain region. It is now known that all land over about 3,000 feet above the level of the sea has those qualities, viz.: that, without shelter, all the domestic animals can find ample food on the nutritious, summer-cured grasses of those plateaus, and that myriads of those animals are yearly raised by the great capitalists and others in our western regions. The experiment has now for so many years been tried, that it is not considered at all problematical, and although winters of great severity may occur, it is admitted that on an average the losses in the herds by the vicissitudes of the weather do not exceed five per cent. of the whole number.

We will first enquire why this fact was so long concealed from the knowledge of the most enterprising and astute of our western inhabitants. We will afterwards explain the philosophy of the cured grasses, and the action of the climate in those high and arid regions; and give some account of the distribution of the various grasses, and set forth how far the peculiarity is one confined to North America, or if found on other continents.

Surely it is extraordinary that so salient a fact as to the resources of this country should not have been fully known until the completion of the Union Pacific Railroad in 1869. My army station from 1852 to 1865 was in Oregon or Washington Territory, and at Omaha from 1867 to 1871. Thus I was thrown in the course of my official travels into regions giving me opportunities for observation, which I embraced. But I must confess that notwithstanding my knowledge of the benefits of the cured bunch-grasses in Oregon east of the Cascade mountains, and my large intercourse with emigrants yearly arriving on the Pacific slope and with the officers and scientists of many exploring expeditions, it was not until during my residence in Omaha and my journeys over the Union Pacific Railroad, that I knew of the immense resources for winter grazing on the Rocky mountain plateaus, which cover probably one-fourth of our whole territory. Our total area is four million square miles, and we can safely add that the region for winter grazing is about a million of square miles, if not more—not including any portion of Alaska.

The moment California, New Mexico and the other territories were acquired from Mexico, in 1848, our Government turned its attention to the Pacific slope, and to the necessity of a Pacific Railroad; and sundry exploring expeditions were organized in 1853 to examine the various routes—northern, southern and central. These expeditions, and those preceding, of Lewis and Clarke, of Long, of Bonneville, and of Fremont, gave to the world a great mass of information of all kinds, concerning those little-known regions.

Each of the Pacific Railroad exploring parties had scientists of the highest repute in various branches of investigation, as geology, botany and natural history, and had with them experienced guides, hunters, woodsmen, mountaineers and prairie men; and all these were as ignorant as the rest of the winter resources of that vast domain! The reason was that all the explorations were made in summer each party returning to winter in lower altitudes in the settlements, without any attempt to discover and unveil the winter characteristics of the mountain regions.

We learned at Omaha that the discovery of the resources of the Rocky mountain plateaus for winter grazing was really made during the war, by the parties under that enterprising man, the late Edward Creighton (afterward President of the First National Bank of Omaha), who had taken the contract to build the telegraph line from Omaha to San Francisco. One winter their animals were left to graze in the elevated pastures of those regions, and were found in the spring in splendid order for the prosecution of their labors. This fact was utilized by Mr. Creighton, and it was the foundation of his large fortune, made in great part by stock-raising in Western Nebraska and Wyoming. These facts soon became known. His friends made no concealment of the important discovery. Indeed, it had almost been anticipated by the experience of many on the plains.* But by the time the Union Pacific Railroad was completed, in 1869, the enterprising capitalists and herdsmen of the West were aroused and ready to avail themselves of this new and promising mode of investment.

---

*From statements received from reliable sources, in reply to recent critical enquiries, we are satisfied that Mr. Creighton was the first to ascertain these facts in reference to long routes, and over such an extensive tract of country, and to induce faith in the resources of the whole Rocky mountain plateau. It seems that Seth Ward, a trader at Fort Laramie, and Mr. Bent, a trader at or near Fort Lyon, had made use in the vicinity of those places of such winter grazing, several years before the war. But their experience was local and unknown to the general public.

If it excites any surprise that so many enlightened army officers of varied experience, scientists, emigrants and explorers, who, since the discovery of gold in California in 1849, had traversed those regions, should have failed to make this discovery, let it be noted that those famous hunters and mountaineers, Daniel Boone, Nathan Boone, Kit Carson, the Choteaus, Mackenzies, and other fur traders, experts, guides and Leatherstockings of the frontier, had also been equally unconscious of the capabilities of a region in which they had spent their lives. Nor could they have gotten the facts from the Indians, who did not themselves know the immense resources of their country.

Neither that peerless, redoubtable hunter, Randolph B. Marcy, nor his senior and companion, Martin Scott (who had accompanied Long's expedition), were exceptions to this statement. They were as hardy, persevering and indomitable hunters as Daniel Boone. Of the latter it was said that in 1818, at the age of 83, he was pursuing the daily chase two hundred miles to the westward of the last abodes of civilized man. Now every summer Marcy, though he has for fifty years been hunting on our frontier, continues with gusto his excursions to the Rocky mountains. It cannot be said of him as of Boone:

> " 'Tis true he shrank from men even of his nation ;—
> When they built up unto his darling trees,
> He moved some hundred miles off for a station,
> Where there were fewer houses, and more ease."

But if Marcy returns to civilization to pass his winters, it is true that he revels in those regions, and he would say with Burns:

> "My heart's in the Highlands, my heart is not here,
> My heart's in the Highlands, a chasing the deer."

Once, in 1859, he employed his leisure in preparing a much-needed book, "The Prairie Traveller." It was a valuable work, creditable to his sagacity, giving much detailed information never before published for young officers and others preparing for expeditions on the prairies; but it did not make known their resources for winter grazing.

In 1868 a treaty was made with the Sioux Indians by officers and Indian agents to whom the trust was delegated. Generals Sherman, Terry and Augur, and Mr. Sanborn (an old Indian agent) of St. Paul, were among the commissioners. The treaty made "special provisions for individuals of the tribe who shall cease to roam and hunt and shall desire to commence farming." But no provision was made to reward, assist and stimulate them to stock-raising, although their country embraced the very choicest regions for winter grazing, and, says Gen. Terry, "the soil and climate are, on account of the frequent droughts, but illy adapted to agriculture."

It is much to the credit of General Terry, commanding the Department of Dakota, that so soon as he became fully apprised of the resources of the land of the Sioux, he incessantly urged the Government to make timely and efficient arrangements to induce those natives of the soil to make trial of pastoral life, that half-way status from barbarism to civilization.*

Habituated carefully to give shelter to our cherished domestic animals, the paradox did not easily dawn upon us that by going a few thousand feet higher on the arid plains in the "Great American Desert" (as it was termed), they, except sheep, could be fattened without cover and without the issue of a pound of forage. The country twenty years ago had such a large and unsettled domain, that we did not then need this information. The knowledge has come just when wanted to supply great and leading demands in our commerce, foreign and domestic.

---

*We are enabled to place in the Appendix, marked A, an extract from a letter of General A. H. Terry of January 26th, 1877, to Senator Allison, then chairman of the Committee on Indian Affairs in the Senate.

We will now undertake to explain the anomaly that the grasses of the arid plateaus are ready at all seasons for grazing, whereas in winter in all these lower altitudes they are not. Heat and moisture will cause the grasses in autumn and in winter to rot. With us they decay and, unless cut in season, cured and made into hay, are lost to use.

In the arid Rocky mountain plateaus the grasses as they stand on the soil are cured in the sun during the summer, the action of heat retaining and concentrating in the stalks the sugar, gluten and other constituents of which they are composed.* This is true of the bunch grasses, the buffalo and grama and many similar grasses, which pervade those regions. It is so cold and so dry in those elevations that there are neither heat nor moisture to rot them. And the snows are so fine (save in some exceptional seasons) in that cold atmosphere, that they are so blown by the winds into drifts, that four-fifths of the soil is never covered by them. Thus the grass is ever accessible to the domestic and other animals, while the snow is so fine that it falls from their backs; therefore they are not encumbered with a coating of frozen snow which in these lower regions would go far toward killing the poor brutes. They find shelter in the hollows, bushes and forests during very severe weather. In the natural abodes of the buffalo, antelope, and other wild animals, it is found that our valued domestic animals can in like manner survive the winter. Millions, countless millions of buffaloes have ever subsisted on the buffalo grass. Although our domestic animals generally prefer the other grasses, the buffalo grass does not fail to be one of their resources.

---

* It is a well-known fact that the amount of nutritious and saccharine qualities in the grasses depends on the heat and dryness of the climate. This is tested by the experiment as to the comparative thriving of stock fed in open meadows and on woodland pastures. Such is admitted by practical farmers in the blue grass region of Kentucky. See page 257 of C. L. Flint, on "Grasses and Forage Plants," Boston, 1859. It is a valuable book, but appeared just before our knowledge of winter grazing in the Rocky mountains. His quotations from Blodget, Fremont and Marcy show how near they approached, without absolutely reaching that knowledge.

An attempt was made to cultivate some of the bunch grasses in Ohio, but they did not retain there (as was hoped) the wonderful nutritious qualities exhibited on the plains. The moisture of the climate is the cause, dissolving and diluting, as it were, their vegetable nutriment. The plant becomes changed when cultivated remote from its native arid habitat.

The difficulties in lower altitudes other than those I have described, have been that after a warm spell and a thaw, the snow freezes to a crust, and the grass is matted down by the ice and kept from the stock. East of the Cascade mountains in the arid portion of Oregon, bunch grasses and cured grasses are found near the Dalles, where it is only three or four hundred feet above the sea. In December, 1852, I witnessed such a thaw followed by freezing, which kept the oxen (left there to winter by emigrants bound to the Willamette) from getting to the grasses, and consequently large numbers died of starvation. If they had been wintered near Fort Boise, or anywhere 3,000 feet above the sea, they would have thrived on the rich bunch grasses ever accessible on those plains. Sheep should always have shelter from the cold winds, but no other stock requires it.

The summer cured grasses are perennials, and in the spring the green fresh shoots push off the old colm or stem, sometimes seen in the new start of growth.

In Texas the grazing grounds are mostly at so low a level above the sea that the grasses rot in winter. Hence, in the latter part of winter, the animals there are often poor, and it is difficult to provide food for them. Thus it is that the vast herds started from Texas to be driven to market acquire flesh and improve every hundred miles of their journey north, as they reach new and well advanced pastures.

This accounts for the apparent anomaly that the cattle in New Mexico, Colorado and Wyoming are in those seasons in so much better condition than the herds in Texas, San Antonio being only 600 feet above the sea, Fort McKavett 2,060, Fort Clark 1,000, the higher plateaus not being reached till we approach El Paso. Thus Texas, long esteemed the choicest region for raising cattle in this country, the very paradise for them, has, for over three-fourths of its area, the important drawback of the decay of its grasses late in the winter, which renders it difficult to subsist their immense herds, as I have heard capitalists from San Antonio deeply lament.

But we must now allude to another element which prepares that elevated region for winter grazing, viz.: that the climate is much warmer than in the regions east of it in the same latitude. The isothermal lines all ascend in moving westward.

At Mount Washington in New Hampshire, 6,300 feet above the sea, it is difficult for the Signal Service soldiers to get through the winter, such is its severity. Whereas at our military posts in the mountain plateaus, six to ten thousand feet above the sea, officers and soldiers have enjoyed great comfort during the twenty or thirty winters they have been occupied by troops. Witness, Fort Sanders, Fort Steele, Wyoming Territory, about 7,000 feet; Fort Bridger, 6,780; Fort Fetterman, 8,500; Fort Garland, 9,000 feet above the ocean. We have witnessed the aggregation of miners at Leadville, nearly 10,000 feet above the sea, with a population of near 20,000, a city as large and as high as Quito in South America.

To comprehend the difference in climate between that Rocky mountain region and the Atlantic States, just imagine a mountain peak in the latter eight or nine thousand feet above the ocean, and the sure impossibility of man or animals living at such an elevation in the winter season!

I had occasion when at Omaha for several years to contrast the winter climate there and at Fort Laramie, Wyoming Territory, which is 3,500 feet higher. The latter is notoriously milder, and more endurable, being fully attested by the records of averages of temperature for thirty years.

At Omaha cattle and horses must have shelter in winter, but none is needed at Fort Laramie. The extreme severity at Fort Buford, Dakota, 1,900 feet above the sea, is, in like manner, contrasted with the weather at Fort Phil. Kearny, on Powder river, 6,000 feet above the sea, or with the winter climate of Forts Custer and Keogh.*

---

* A very thorough digest of the statistics of the climate, including temperature, humidity, prevailing winds and their velocity, the number of cloudy days, &c., appears in "Science" for October 5th, 1883, by Dr. S. A. Fisk, of Denver, Colorado. He thus explains fully why that region has a climate promoting good health, and invigorating to many invalids. He says: "We have

Scientists are not yet able to assign satisfactory reasons for these anomalies—perhaps they are inscrutable. Why in ascending the slopes of the Rocky mountain plateaus a warmer winter climate should be encountered is a proper field for future consideration and investigation. It still remains a paradox. The reduced relative humidity is not a sufficient reason. That the currents of wind are made warmer by passing over arid plains would hold good in summer rather than in winter. In winter these currents often pass over snow-clad mountains, and when our cold weather east of the Mississippi is referred to northwest winds coming from those regions, how can we attribute to the same winds the unexpectedly mild winters of many parts of Montana and Wyoming. It would not be surprising if the true cause should be found in internal heat. Abundant traces of past volcanic action are found throughout the whole Rocky mountain region from the 49th parallel to Arizona.

The mild winter climate of California and Oregon can be readily traced to prevailing southerly winds in that season,

---

seen, that so far as conditions of sunshine, humidity and rain and snow fall are concerned, the invalid can lead an out-of-door life a greater percentage of the time in Colorado" (and the same holds good of a large share of the whole Rocky mountain slope) "than anywhere else in this country. An experience of several years warrants the writer in asserting that an invalid can with perfect comfort and safety, spend several hours in the saddle, nearly every day of the three hundred and sixty-five.'

The inference is irresistible that a climate thus promotive of vigor, health and energy in the human race, would for like reasons conduce to the growth and well-being of all the domestic animals.

In the "History of the American Bison," by J. A. Allen (a very exhaustive monograph), in reference to the emigration westward in the southern range of the buffaloes, as winter appoached, from the region in western Kansas, he accounts for it by "*the greater mildness of the winters to the westward.*" (Report of U. S. Geological Survey, 1877, p. 466.)

but such conditions do not prevail in the regions farther east. These remarks offer a topic well worthy the future investigation of the scientific world.

We can make the following statement as to the region higher than 3,000 feet above the sea, fit for winter grazing. It includes all, nearly up to the timber line, of Montana, Idaho, Wyoming, Utah, Nevada, Colorado and New Mexico, and five-sixths of Arizona, one-half of Dakota, one-third of Nebraska, one-fifth of Kansas, one-fourth of Texas, and one-sixth of each, California, Oregon and Washington Territory. This embraces, as we have already said, about one-fourth of the area of the whole United States.

By the courtesy of Gen. F. A. Walker, superintendent of the last census, I have received a statement of the "Estimated number of ranches and range stock not taken by enumerators on farms." Therefore this gives the number of animals in each State and Territory in 1880 which subsisted by grazing in the manner we have described, including some in Texas and the Indian country not on the high plateaus. The full table will be given in Appendix B. But we will here state that it makes the total of cattle near four millions, and the total of sheep seven millions—a very low estimate. It contains no statement of the number of horses and mules.

Strange enough, all the best authorities who have had opportunities for comparison say that those regions farthest north are best. Brisbin, page 90,* says: "Montana has undoubtedly the best grazing grounds in America, and parts of Dakota stand next."

---

*This is from Colonel J. S. Brisbin's book rejoicing in the tempting title "The Beef Bonanza," Lippincott, 1881. It contains a mass of statistics put together without method, but containing such as are difficult to be found elsewhere.

Generally the animals graze, summer and winter, in the same region. Sometimes, but rarely, they are driven in winter to lower levels. A friend, who accompanied Captain Dutton's exploration of the Grand Cañon of the Colorado in the summer of 1881, informs me that he met the owner of large herds whose grazing grounds were on that large high tract in Northern Arizona (36½ N. latitude) called "Kaibabs plateau," near 10,000 feet above the sea. Though it was his custom to drive the herds to a lower level in winter, yet in the previous winter it so happened that a large number of animals remained there the whole season and were in the Spring in fine condition. It certainly is wonderful that they could thrive at such an elevation. It was doubtless because in storms they were able to find shelter and food in the hollows and cañons, where, besides the cured grasses, there are many edible bushes, chapparal and undergrowth pervading the pine and juniper forests of that remarkable plateau, giving the animals very acceptable browsing.

When Sir George Simpson, President of the Hudson's Bay Company, published his travels "Around the World," and on the Pacific Coast in 1841, he evidently wished England to acquire California, and even predicted that as the United States could send few settlers by sea, they could not people Oregon with emigrants passing over the dreary intervening desert regions west of the Mississippi.

Images of prosperity in those fertile prairie lands (termed by Bryant "the unshorn fields boundless and beautiful") in the valleys of the Mississippi and its tributaries have for a century excited the desire of myriads, in our own and foreign lands, to seek our Western country with a view to get agricultural homes. Twenty years ago any flattering use of the arid regions and the mountains would have been derided, for it was supposed that only in summer could their grazing facilities become available.

But it is pleasant that now such gleams of satisfaction can arise when we reflect on the important objects to which they are devoted.

Pastoral life from the earliest times has always excited the imagination of the poets. When we glance at the whole wide region referred to, continental in size, reaching the whole extent of our domain from north to south, and fancy we see, at one elevated bird's-eye view, the vast fields now inhabited, summer and winter, by innumerable herds, almost crowning the summits of the mountains, we exclaim: What would Virgil have written if his vision had been filled with such a prospect? His "Bucolics" would then have had a topic, if not more beautiful and idyllic than the rich fields and verdant meadows of Italy, yet far more grand and inspiring.

But it is not the insight of the poets we would now consider so much as that of the scientists, and whilst I have been reperusing the charming pages of Humboldt in his "Cosmos," dwelling on the "Aspects of Nature," in the plateaus of Central Asia (in vain searching to see if he described similar characteristics in that region), I have been led to reflect how a mental survey, such as I have just described, would have gratified him, and what abundant material it would have afforded for one of his glowing and eloquent paragraphs on the resources of North America. He watched keenly all the explorations of our Pacific Railroad parties, and read with avidity and approbation* all the valuable reports and annotations of their observations.

If it is desirable to give to this pastoral glimpse at the present uses of those plateaus forming the immense backbone of this continent, the benefit of a vivid contrast with their former history; if we wished to find not a pastoral but an epic picture for the background, we might recur to it as once the chosen abode of wild animals, grizzlies, elk, deer, antelopes, besides innumerable herds of bisons and tribes of Indians, skillful hunters of powerful physique, deeply imbued with the warlike and heroic traits of those races, whose achievements doubtless furnished ample material for many a barbaric Iliad.†

This brings me to refer to the timeliness of the discovery of the winter grazing in the Rocky mountains, as those Indians are now subdued, and are likely to give little trouble hereafter to the shepherds and herders.

If the gold in California had been discovered a few years earlier it would have been comparatively lost to the United States, as it would have been under Mexican rule. The capacity of California for wheat production became well known just when a large proportion of its people of enterprise, bone and muscle, tired of mining and roving, were glad to settle down to agricultural life. And this knowledge of winter grazing in our vast domain came when our agricultural settlements in their westward progress had touched those regions, when the railroads had made them accessible, when the Indians will permit us to use them unmolested, and when the want of meat in the whole civilized world has demanded that all such resources should be utilized.

---

* See Humboldt's letter to Major A. W. Whipple, printed in one of the volumes of his explorations of a central route. Humboldt did not die until 1859.

† This is no fiction. The aboriginal tribes have their epics and Iliads, the records of boasted warlike deeds, in the shape of pictures and hieroglyphics, carefully painted on a buffalo skin (with ornamental border), setting forth their triumphs in war, whether with a neighboring tribe or with the whites. Curious examples of this habit have been seen by the writer on the frontier in our day.

In presenting to this society this subject, I have been desirous of stating to what extent the other continents in their higher plateaus have the same characteristics. Finding, as I have hinted above, nothing whatever in Humboldt's admirable chapters in "Cosmos," on the plateaus of Asia, I began to examine other authorities. First, I will quote a few sentences from a note to me of Dec. 16th, 1882, by Prof. A. Guyot, the distinguished Professor of Physical Geography, &c., in Princeton College. In reply to my queries, he says: "I have carefully searched the two large works on Geographical Botany, which are in my library, viz.: A. Delandolle's 'Geographie Botanique raissonnée,' and Lecoq's 'Etudes de Geographie Botanique,' to find something relating to the questions contained in your letter, but without success. The last work devotes nearly 200 pages to the graminées, but does not mention the cured grasses. As this quality of grasses depends, as I believe, upon climatic conditions, which prevent the destruction of their nutritious power by fermentation, it seems to me that the dry portions of the Andes and of the plateaus of Brazil should afford cured grasses as we find them in California and the Rocky mountains."

This letter has naturally stimulated me to considerable laborious research in the best works upon the subject, and to some personal enquiries of travellers. Indeed, it has absorbed more of my time in preparing to write this paper than any other topic.

In reference to Asia I have examined two works of Col. Prejevalsky of the Russian army, an adventurous and indefatigable traveller in the last eight years in the "Tangut country and Northern Thibet"; the work of Frederick von Hellwold on "The Russians in Central Asia"; Sir Joseph D. Hooker's "Himalayan Journals"; and the address of Sir Richard Temple, on the central plateau of Asia, at the British Association for the Advancement of Science, at Southampton, in August, 1882, to the section on Geography, of which he was chairman. Also, William Griffith's "Posthumous Papers bequeathed to the Honorable East India Company," containing "Itinerary Notes of Plants collected in the Bootan mountains, 1837–38," and "Botany of the Himalaya mountains," by J. F. Royle, M.D., Vol. 1, folio, London.

I find nothing in all these works about summer-cured grasses, although there are allusions to winter grazing. I think, from a conversation with Sir Richard Temple, since I read the above-named address, that in Thibet and Turkistan it is customary to drive the domestic animals in winter from high plateaus to lower. This doubtless referred to very high plateaus. For Huc, in his "Travels in Tartary and Thibet" (5th edition in French, Vol. 2, p. 224), speaking of the wild oxen of the Thibetan deserts, says: "During the summer they descend into the valleys to quench their thirst at the streams and lakes; but during the long season of winter they remain upon the heights and are contented with eating the snow and some herbs of extreme durability" (dureté.) * This is the opposite of the cus-

---

* I am indebted to Prof. Benj. Smith Lyman, of Northampton, Mass., for this extract from Huc. His geological explorations in India did not extend to those plateaus.

tom above referred to, and can be ascribed doubtless to the same conditions which we have described as existing in Texas. In its lower plains the grass would in winter decay, but if the cattle were driven to the arid regions of Northern Texas and New Mexico, nutritious cured grass would be found ready for the animals, as we have fully explained. Some of the descriptions of Western China or Chinese Tartary, by Richthopens, Vol. 1st, contain facts similar to those above quoted from Huc.

In Raphael Pumpelly's interesting work, "Across America and Asia," published in 1870, there are no direct allusions to the same conditions existing in Asia as in our Rocky Mountain plateaus. But he says, page 376, "The atmosphere of Central Asia is intensely dry, because the winds reach it from every direction only after having deposited their moisture on the broad belt of low lands and the high mountain peaks which intervene between the table lands and the oceans." Page 381 he says: "The sandy plains, which through the whole length occupy a width of 100 miles or more, form a dreary waste. But as we leave this going north or south we traverse the great grassy plains, which alone render the country habitable, and from which it gets its name—the land of grasses." In another place, page 369, he speaks of the plains as "covered in summer with a wavy mass of tall grass." From this we judge it unlike our various bunch and gamma grasses, which occur literally in bunches and do not form a turf.

In reply to a note from me, Mr. Pumpelly says, Feb. 2d, 1883: "I beg to say that, so far as my observation goes, the same conditions exist in Central Asia on the plateaus as on our western plains. The atmosphere is there (in

Asia) so dry that little snow falls anywhere on the plateau west of Manchuria, and, between the high winds and rapid evaporation at even a low temperature, the grass remains accessible to the herds of cattle, sheep, horses and camels."

As to the remarkably nutritious character of the grasses of some of the plateaus of Central Asia, we will quote the following from the address of Sir Richard Temple, above referred to: "The pastoral resources of that region have proved astonishing. For many years the Tartar emperors maintained in the field at least 500,000 cavalry, for which the horses were drawn chiefly from that plateau.

"The pasturage was so potent in nutritious qualities that ordinarily there was risk of animals suffering from repletion, and emaciated creatures gained flesh and strength."

I note that he names as abounding "the pointed grasses, sharp enough to pierce leather, &c."

It is remarkable in Central Asia what contrasts are exhibited. Prejevalsky descants on the inviting regions of Southern Siberia, though so much farther north, as contrasted with the fearful desert on his route in latitude 41°, commencing five degrees west of Pekin, thence to the Munniüta range.

Hooker says, speaking of the Himalaya mountains, "a flock of hornless sheep was seen grazing on short sedges and fescue grass in the middle of October, 18,000 feet above the sea."

Hellwold says, p. 82, &c., the country north of Kabul (which is in latitude 34° N.) is like the valleys of Cashmere. "Although the level plain of the valley lies 6,000 feet high, yet it is toward the west and the north, owing to the shelter of the snowy range above, verdant with meadow land and luxuriant with gardens. Here the profusion of snow-white blossoms in spring and the rich abundance of fruit in summer and autumn, have from time immemorial been sung with ecstatic praise. Even the cattle are fed on grapes for three months in the year!"

The *Steppes* of Southwestern Russia, like the pampas of South America, are generally too low in altitude to have the characteristics of our Rocky mountain region. They are covered with snow in winter, which on occasion may melt and then freeze, and thus become very injurious to the domestic animals.

It therefore is evident that the whole question concerning Asia remains to be more fully illustrated by the observations of future travellers, and to make the desired comparison between the grasses and forage plants and winter grazing of its central plateaus and those of the United States.

In reference to South America, I have examined several works on that region and cannot find that those characteristics exist in the plateaus of that continent. I find nothing in the "Voyage of a Naturalist," 1840, by Charles Darwin, on the *Beagle*. If similar facts had existed they would surely have attracted the attention of that scientist, so celebrated for his close and keen observation. As already stated, the pampas of the Argentine Republic are generally too low to exhibit the qualities we refer to.

I examined with great care a very comprehensive work, sent from the Argentine Republic to the Centennial Exhibition in 1876, at Philadelphia, entitled "The Argentine Republic," by Richard Napp, Buenos Ayres, 1876. It says,

p. 106, "The high Cordilleras, although they do not always offer grazing grounds to the cattle, are, notwithstanding, a slight resource to them when otherwise they would die of hunger. Here and there between the Monte Formation and that of the Pura a green and magnificent belt of true alpine vegetation is found, which is rich in graminæ, refreshes the sight of the traveller who has just crossed those wastes, and it is also a resource for the droves of cattle."

At the instance of our minister to Brazil, Hon. Thomas O. Osborne, I consulted Mr. J. Parker Read. He wrote me, Dec. 28, 1882: "I have travelled quite extensively over South America, but have not made special notice of the subject referred to by you, but my observations have been to the effect that such part of the Pampas of the Argentine and the plateaus of Chili and Bolivia as are of value for grazing purposes are not subject to severe cold and snow storms as our west at all, the divisions of seasons being marked by cold and chilly rains only. In the spring the Argentine pampas are covered with a nutritious growth of tufty grasses, which dry and cure on the ground during the summer droughts, but like our prairie grasses are still nutritious. In the higher regions (plateaus of eight or twelve thousand feet) inhabited by the guanacos, Vicenna, Alpaca, &c., the snowstorms are, as you say dry, and drifting, and these animals are driven down in front of them to the lower plateaus for winter feeding when they are hunted—that is, on the snow border."

From personal inquiries of travellers who have been in the mountain regions of Peru and Bolivia, I infer that their domestic animals subsist in winter very much on the bushes and chapparal found on the plateaus.

In reference to Africa I find even less on that topic than was accessible concerning South America.

I have examined that celebrated work, "Travels and Researches in South Africa by David Livingstone," and can find nothing germane to my enquiries. He extols a plateau (p. 582) in about latitude 17° S. and longitude 27° E., 5,000 feet above the sea, which "may be recommended as a sanitarium." It is in the Batoka mountains midway between the Atlantic and Indian oceans.

"This ridge has neither fountain nor marsh upon it, and east of the Kalomo we look upon treeless, undulating plains covered with short grass. The eastern ridge is not more than three hundred miles from the Indian ocean. That plateau merits inquiry for it affords a prospect to Europeans of situations superior in point of salubrity to any of those on the coast."

In the interesting paper on "Dutch South Africa" by Col. Aylward, published recently in one of the bulletins of this Society, nothing appears to indicate the existence there of a parallel to the climate of our plateaus. The two Republics of the Orange Free States and the Transvaal extend from 23° to 31° south latitude, and their plateaus are from six to eight thousand feet above the sea, and have fine grazing for cattle and sheep. But their rains are in the summer, whereas on our western plateaus they are in the spring.

The Cape of Good Hope is in about the latitude of 35° S., and thus the whole continent does not reach a climate similar to that of our northern central pasture lands, but might assimilate more to that of Mexico.

If thus little is known of the existence of similar characteristics of winter grazing on other continents, if they exist and are utilized, only travellers have not made them a topic, or if they exist and have not been known and used, it is well for us to bear in mind that our race, the universal Yankee nation, with its boasted activity and enterprise, was for near a century in contact with our central plateaus, but profoundly ignorant of their real capabilities.

I shall now give some account of the various grasses which are found on the plateaus, and which are summer cured. In Appendix C will be found a letter to me, of March 1st, 1883, from Dr. George Vasey, botanist of the Department of Agriculture, who has complied with my request to give me a concise statement of the names of the principal grasses.

In general parlance it has been supposed that what are called "bunch" grasses are in the northern portions of the Rocky mountain range, and that the "gama" or "grama" grasses were peculiar to the southern territories in New Mexico and Arizona. But I am satisfied from personal enquiries of travellers (Marcy and Dutton among others), as well as from the statements of the botanists, that both the "bunch" grasses and others are found in each region. But it seems probable that the "gama" and "grama" grasses are found in the greatest abundance in the more southern portion. The "buffalo" grass or grasses (for the term is applied to more than one kind) are found throughout all the ranges of the buffaloes from north to south.

The term "bunch" grass was given because it grows in tufts or bunches a foot or more in height, sometimes two feet apart, so that the aspect from surrounding hills would often be that of a desert region. A green carpet is never or rarely seen. The buffalo grass grows as a low turf, and it is summer-cured, as it grows, like the other grasses under consideration.

By the courtesy of Gen. F. A. Walker, Superintendent of the Census, I had the privilege of reading (before publication) a full and interesting paper by William H. Brewer on "Pasture and Forage Plants." In the following statement I have often availed myself of some items from it.

The term "bunch grass" has been applied to several kinds, and we will name those prominently known.

The *Festuca Scabrella* is the one best known on the Pacific slope, ranging from California to Oregon and Idaho. The *Festuca Occidentalis* is also found there. The *Festuca Ovina* (or "sheep grass") in several varieties is found through the whole region of winter grazing, and seems the world over to be found wherever sheep graze. *Eriscoma Cuspidata* is one of the valuable bunch grasses generally prevalent.

Of the grasses termed "grama," *era-grostis poaevidis, era-grostis oxilepsis* are called grama grasses, the former in Texas sometimes called one of the buffalo grasses.

Munroa Squarrosa, Mr. Brewer says, is a buffalo grass of the north, and one of the grama grasses of Texas. *Calamagrostis longifolio* has a wide range and is sometimes termed "*mesquit*" and grama grass; and *Calamagrostis Canadensis*, sometimes called "blue-joint."

The terms "grama" and "gama" are not interchangeable. Brewer says that *Tripsacum Dactyloides* is the *gama* grass of the South—a tall coarse grass from three to seven feet high—and "is found from Texas to Illinois and Connecticut."

Though much confusion of names are in popular use in reference to all the grasses, it seems to be admitted that the term buffalo grass is applied most justly to *Buchloe Dactyloides.* It is one of the most nutritious of grasses and pervades the whole range of the Rocky mountain plateaus.

But the number of different grasses found in those regions is very numerous, so that the enumeration made by Prof. Vasey, or even the fuller statement of Mr. Brewer only name some of the principal grasses. The latter even says: "It is probable that more than a hundred and fifty species of grasses or allied plants form an appreciable element of the pasturage of the region under consideration. California is the only State of the region whose botany has been elaborated and published." * * * * "The list of Western forage grasses must therefore remain incomplete until the region is more thoroughly studied botanically."

Thus these papers can at least have one effect, to show that there is a promising field for more research, for elaborate treatises on the botany of that region.

One of the first enquiries of the political economist will be, How lasting will this resource of winter grazing be? Can these plateaus be thus utilized a half century hence? Doubtless the crowd of animals will soon be so great that these pastures will be bought and fenced in to a great extent. Even now such precautions are beginning to be taken. Still, for a long time the wide unsettled domain, especially the uplands, will be open to the public. The land bordering streams of water or at least ending on such streams, will be in demand.

This ownership will lead to experiments; such as are alluded to by Mr. N. S. Shaler in a recent number of "Science," or such as were set forth in a very thoughtful paper on this subject by Elihu Hall, a botanist of Athens, Illinois, at page 225 of Horace Capron's Agricultural Report for 1870. It is yet to be decided whether some of the cured grasses now such favorities will be consumed, trampled out and exterminated by the myriads of cattle. In Oregon and California the farmers at once ploughed their pasture land and sowed grass of a kind better fitted for permanent cultivation and denser in growth than the native grasses. It remains for the great future to ascertain what grasses can be cultivated in the higher plateaus. Mr. Hall gives a list of some worthy of trial. It is well known that European grasses have been introduced in this country, and have covered whole States by their persistent powers of spreading, native grasses giving way before them.* Witness the Kentucky blue grass, east of the Rocky mountains, and in California the wild oats, which now pervade a large portion of the uplands of that interesting State. Also in that State the Chilian *Alpalpa*, a valuable forage plant, has been successfully introduced. The naturalist or agriculturist early in this century would not have dreamed in his wildest prognostics of the future, that so many valuable foreign vegetables, grasses and fruits, would eventually pervade the United States.

Thus there is every encouragement to hope that time, enterprise, experiment, and persevering culture may accomplish much to preserve and perpetuate the advantages now so characteristic of our interior plateaus.

---

* In an article by Robert Brown in the English "Geographical Magazine" 1874, "On human agency in the dispersion of plants," he says: "Thus a grass (*Stipa textilis*) has invaded the Southern Russian steppes, and is rapidly displacing almost every other plant. Plants introduced into India since it was first visited by Europeans now range from Cape Comorin to the Himalayas."

This society must always be desirous of suggesting for travellers and scientists new fields of observation and investigation. Therefore, in conclusion, I will recapitulate the *desiderata* alluded to in this paper.

1st. How far do these characteristics extend to the plateaus of other continents?

2nd. Why is the climate of our interior plateaus so much milder than that of the regions in the same latitude east of them?

3rd. The best botanists aver that it remains for future explorers to make of that region a complete exhibit of their plants and their geographical distribution.

4th. Experiments and cultivation are needed to determine how these valuable capabilities can be perpetuated.

APPENDIX A.

The following is an extract from a letter of General A. H. Terry, of 26th January, 1877, to Senator Allison, Chairman of the Committee on Indian Affairs, U. S. Senate.

"It appears to me that most of the efforts to civilize Indians which are made by the Government are infected with a fatal error, the error of passing over, or rather attempting to pass over, one of the natural steps in the progress of civilization.

"Savage tribes, whose wants are supplied by the chase, never of their own accord suddenly abandon their nomadic habits and become cultivators of the soil. Uniformly they pass through an intermediate condition—the pastoral state. It cannot be supposed that the savage forefathers, even of those nations which are now the very flower of civilization, could have overleaped this necessary step. It is doubtless true that such a change in mode of life can be brought about more easily when a savage tribe comes in contact with, and under the control of a civilized people. In such case the savage has not to discover for himself the art of cultivating the earth; it is taught him; but savage habits remain; savage love of freedom to roam; savage impatience of constraint; savage hatred of persistent labor; and these are obstacles difficult to overcome;—they are almost insurmountable.

"Why the first step in the progress of civilization should be to the pastoral state is readily discovered. It is the step which is most easily made because it involves a comparatively slight change of habits. The new condition imposes but little constraint; it requires no constant labor.

"The Sioux treaty of 1868 fairly illustrates the course of thought which has controlled the Government in its efforts to civilize Indians; the results obtained by action under it show what may be obtained by such a policy.

"That treaty makes special provision for individuals of the tribe who shall cease to roam and hunt and shall '*desire to commence farming.*'

"The cultivation of the ground seems to have been considered the only alternative to 'roaming and hunting.'

"In effect, many of the Sioux who were parties to that treaty have ceased to roam and hunt; but very few of them have commenced farming. Gathered around the national almshouses called agencies, they are for the most part an idle, listless, worthless people, living simply to eat the food and wear the clothing provided for them by the Government.

"Even if it were easy under ordinary circumstances to convert an adult savage into a civilized farmer, it would be almost impossible to accomplish this in the country reserved for the Sioux by the treaty of 1868. There, in three years out of four, droughts or grasshoppers destroy whatever crops may be planted. There even a skilful husbandman would despair of obtaining a subsistence. Is it to be supposed that a savage can be made to appreciate the superior advantages of a farmer's life, where the cultivation of the ground consists almost exclusively of ploughing and planting—where a harvest is seldom known?

"Unless some change in the system of management be made these bands will be a heavy burden on the Government for many years to come."

APPENDIX B.

ESTIMATED NUMBER OF RANCH AND RANGE STOCK 1880, NOT TAKEN BY ENUMERATORS ON FARMS.

[*Prepared for Report of Census of* 1880, *and obtained from that Bureau.*]

	CATTLE.	RANK IN NO. OF SHEEP.	SHEEP.	SWINE.
Texas	810,093	3	1,240,000	499,252
Indian Territory	487,748	16	55,000	773,931
Colorado	444,653	5	345,000	3,229
Nebraska	354,697	17	48,000	377,178
Montana Territory	255,892	12	95,000	4,912
Wyoming Territory	243,140	6	310,000	352
Oregon	181,773	8	285,000	22,973
New Mexico Territory	181,235	1	1,850,000	10,302
California	150,737	2	1,575,000	264,869
Idaho Territory	106,290	13	90,000	7,449
Florida	91,025	15	49,000	28,549
Arizona Territory	90,774	4	390,000	4,630
Kansas	82,076	9	130,000	86,274
Dakota Territory	65,968	14	55,000	2,316
Washington Territory	63,630	11	96,000	1,246
Public Lands	58,450	....	....	....
Nevada	44,602	10	97,000	85
Utah Territory	37,239	7	290,000	3,423
Totals	3,750,022	....	7,000,000	2,090,970

APPENDIX C.

(Letter from Dr. Geo. Vasey.)

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF BOTANY,
WASHINGTON, March 1st, 1883.

GEN'L BENJ. ALVORD.

Dear Sir:

In reply to you request I offer the following remarks on the native grasses of the great plains and arid portions of the West. These grasses furnish the chief resource of the immense herds of buffaloes and the vast droves of domestic animals which feed upon the plains, and from the habit of growth are, for the most part, known under the name of bunch grasses. They are chiefly grasses of rigid aspect, at least as respects their culms and leaves, some of them, however, forming a diffuse and elegant panicle of flowers. The most important of the bunch grasses may be briefly mentioned as follows: Of the genus *Stipa* there are several species, *Stipa comata* and *S. setigera* occur abundantly in New Mexico, Texas, Arizona and the drier regions of California reaching to Oregon. In Colorado, Kansas and all the prairie region northward, stretching into British America, the *Stipa juncea* is the principal one of the genus. On the higher plateaus and near the mountains the *Stipa viridula* is very common, extending from Arizona to Oregon and British America. Somewhat related, botanically, is *Eriocoma cuspidata*, a very rigid bunch grass with a fine, handsome panicle of flowers. It is equally widespread with the preceding.

Another widely diffused grass is *Aira caespitosa*, varying much in size and thriftiness according to the altitude and amount of moisture where it grows, but always having a light, elegant, spreading panicle of silvery-grey flowers. One of the most extensively diffused grasses is *Koleria cristata*, varying in height from one foot to two and a-half feet, with a narrow and closely flowered spike. Several species of Fescue grass (*Festuca*) are intermixed with the vegetation in varying proportions; the most important of these are probably the *Festuca ovina* in several varieties, and *Festuca scabrella*, the latter especially in California, Oregon and Washington.

The genus *Calamagrostis* furnishes several species which contribute largely to the vegetation of this region. They are mostly tall, stiff, and coarse grasses, but leafy, and some of them very nutritious. Of these *Calamagrostis sylvatica* and *C. stricta* are least valuable. Perhaps the best of them is *Calamagrostis Canadensis*, which is soft and leafy. Next perhaps in value is *C. Aleutica* of California and Oregon, extending into Alaska. *Calamagrostis longifolia*, confined chiefly to the plains east of the Rocky mountains, is tall and reed-like, growing in dense clumps from four to eight feet high. Several species of *Andropogon* are diffused from Arizona to British America on the plains, but are not found on the western coast. They are, however, not properly called bunch grasses, as their habit of growth is more spreading. The principal species are *Andropogon, scoparius*, *A. furcatus* and *A. nutans*. Some of them are known through the plain region as Blue-joint or Blue-stem. Others more sparingly spread are several species of *Poa* and *Glyceria.* Several varieties of *Triticum repens* or couch grass occur abundantly in saline soils, and are among the most nutritious of grasses. *Brizopyrum spicatum* and species of *Vilfa* and *Sporobolus* also form extensive patches or salt meadows in saline soils. Besides these grasses already mentioned, there are a number of low growth and more diffused habit, which are known in the southwest and east of the Rocky mountains under the names of Mesquit and Buffalo grasses. The former belong mostly to the genus *Boutilona*, the most important species being *B. curtipendula* or tall Mesquit, and *Boutilona oligostachya* and *B. hirsuta* or low Mesquit. The true Buffalo grass is, botanically, *Buchloe dactyloides*, which in some places forms extensive fields of its low and densely tufted growth. Another similar grass, spreading out in low patches, is *Munroa squarrosa.* The above-mentioned species form the larger proportion of the grassy vegetation of the great plains.

Respectfully,

GEO. VASEY,
Botanist.